ID de Contribution: **3** Type: **ÉTOILES A NEUTRONS, SUPERNOVÆ ET SYNTHÈSES DES ÉLÉMENTS LOURDS**

The use of non-unified equations of state and its consequence on the modelisation of macroscopic parameters of Neutron Stars

mardi 12 octobre 2021 13:30 (15 minutes)

The observation of macroscopic features can help us investigate matter of Neutron Stars's deepest layers in conditions of density that cannot be reproduced on Earth. The bridge between dense matter physics and Neutron Star observation is provided by the modelisation of macroscopic parameters such as the mass, the radius or the tidal deformability via relativistic equations of hydrodynamics. A common practice within the astronuclear physicist community is to construct nuclear models for Neutron Star interior separately for the crust (lattice) and the core (homogeneous matter) and then gluing both regions to construct an equation of state for the whole star. Using a nuclear model that has not been calculated consistently for the core and the crust, can result in artificial errors that can surpass the observation precision of current and next generation detectors. We propose to expose the importance of using unified equations of state and to understand why errors appear on the microscopic level to reverberate on the macroscopic scale. The role of non-unified equations of state in analytical representation as well as "universal" relations is also investigated.

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Classification de Session: Groupe de Travail: Etoiles à neutrons, supernovae et synthèse des éléments lourds